Af/2826

Attorney Docket No. 2269-3817US

NOTICE OF EXPRESS MAILING

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Person making Deposit: Jon Wentz

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Serial No.: 09/385,584 Group Art Unit No.: 2826

Filing date: August 27, 1997 Examiner: F. Abraham

For (title): METHOD OF DISPOSING CONDUCTIVE BUMPS ONTO A SEMICONDUCTOR DEVICE AND SEMICONDUCTOR DEVICES SO FORMED

TRANSMITTAL OF APPEAL BRIEF (PATENT APPLICATION – 37 C.F.R. § 192)

Box Interference
Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

1. Transmitted herewith in triplicate is the APPEAL BRIEF in this application with respect to the Notice of Appeal filed on September 16, 2002 .

2. STATUS OF APPLICATION
This application is on behalf of
[X] other than a small entity
[ ] small entity

3. FEE FOR FILING APPEAL BRIEF
Pursuant to 37 C.F.R. § 1.17(f) the fee for filing the Appeal Brief is:

[ ]	small entity status	$160
[X]	other than a small entity	$320

4. EXTENSION OF TIME

[ ] A petition for Extension of Time for a month extension of time for filing the Appeal Brief is enclosed.

5. FEE PAYMENT

[X] Check No. 3304 is enclosed in payment of the fee for filing the Appeal Brief plus any extension of time for which a petition has been filed.
[ ] Please charge this fee to deposit account No. 20-1469 (a duplicate copy of this notice is enclosed--see below).

Any additional appeal fees which are not otherwise submitted herewith or which are insufficient should be charged to deposit account no. 20-1469. A duplicate copy of this notice is enclosed. Please address all communications in connection with this appeal to the address indicated below.

Respectfully submitted,

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Date: November 14, 2002
Enclosures: As identified above

#19 Appeal Brief 12/3/02 ARJ

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:

Ball et al.

Serial No.: 09/385,584

Filed: August 27, 1999

For: METHOD OF DISPOSING CONDUCTIVE BUMPS ONTO A SEMICONDUCTOR DEVICE AND SEMICONDUCTOR DEVICES SO FORMED

Examiner: F. Abraham

Group Art Unit: 2826

Attorney Docket No.: 3817US (97-1350)

NOTICE OF EXPRESS MAILING

Express Mail Mailing Label Number: EL740518132US

Date of Deposit with USPS: November 14, 2002

Person making Deposit: Jon Wentz

BRIEF ON APPEAL

Commissioner of Patents and Trademarks
Washington, D.C. 20231

Attention: Board of Patent Appeals and Interferences

Sirs:

This brief is submitted in TRIPLICATE pursuant to 37 C.F.R.§ 1.192(a) and in the format required by 37 C.F.R. § 1.192(c) and with the fee required by 37 C.F.R. § 1.17(c):

(1) REAL PARTY IN INTEREST

U.S. Serial No. 09/385,584, the patent application at issue in the above-referenced appeal, has been assigned to Micron Technology, Inc. ("Assignee"). The assignment has been recorded with the United States Patent & Trademark Office ("Office") at Reel No. 10207, Frame No. 0301. Accordingly, Micron Technology, Inc. is the real party in interest to the above-referenced appeal.

(2) RELATED APPEALS AND INTERFERENCES

Neither Appellant, Appellant's representative, nor Assignee is aware of any pending appeal or interference which would directly affect, be directly affected by, or have any bearing on the Board's decision in the above-referenced appeal.

(3) STATUS OF CLAIMS

Claims 33-37 and 41-56 are currently pending in the above-referenced patent application. Claims 33-37 and 41-56 stand rejected.

Claims 1-32 and 38-40 were previously cancelled without prejudice or disclaimer.

No claims have been allowed.

The rejections of claims 33-37 and 41-56 are being appealed.

(4) STATUS OF AMENDMENTS

Claims 1-56 were initially filed in the above-referenced patent application.

Pursuant to a Restriction Requirement, dated November 15, 2000, an election was made to prosecute claims 33-37 and 41-56 in a response that was filed on November 27, 2000. Restricted-out claims 1-32 and 38-40 were canceled without prejudice or disclaimer in that response.

A first Office Action on the merits of claims 33-37 and 41-56 was mailed on March 14, 2001. Each of claims 33-37 and 41-56 was rejected in the first Office Action.

On June 4, 2001, a response to the first Office Action was filed. None of the claims was amended in that response.

Each of claims 33-37 and 41-56 was again rejected in a first Final Office Action, which was mailed on July 16, 2001.

In an Amendment Under 37 C.F.R. § 1.116 filed on September 17, 2001, it was proposed that claims 33, 35, 42, 43, 45, and 49 be amended.

The claim amendments were not entered, as evidenced by an Advisory Action that was mailed on October 9, 2001.

Thereafter, on October 15, 2001, a Request for Continued Examination was filed to facilitate entry of the amendments to claims 33, 35, 42, 42, 45, and 49.

Once again, in an Office Action dated December 31, 2001, claims 33-37 and 41-56 were rejected. The December 31, 2001, Office Action was improperly identified as a Final Office Action.

In an Amendment dated February 21, 2002, amendments to claims 33, 35-37, 41-43, and 45-49 were presented. After the February 21, 2002, Amendment, no further claim amendments were made.

Another, non-final Office Action was promptly mailed on February 27, 2002. Yet again, claims 33-37 and 41-56 were rejected.

A response to the February 27, 2002, Office Action was filed on April 25, 2002.

In a Final Office Action that was mailed on June 14, 2002, the rejections of claims 33-37 and 41-56 were maintained.

Yet another response was filed on August 14, 2002.

On September 11, 2002, an Advisory Action was mailed, again maintaining the rejections of claims 33-37 and 41-56.

Finally, a Notice of Appeal was filed on September 16, 2002.

(5) SUMMARY OF THE INVENTION

The invention disclosed in the above-referenced patent application and recited in the claims thereof includes a pre-formed solder mask that is configured to be positioned over a substrate, such as a semiconductor device. Page 9, lines 11-14, FIGs. 1 and 2. The pre-formed solder mask includes a film and at least one open aperture formed through the film. *Id.*

The film, which has a substantially uniform thickness, is formed from a polymer. One of the surfaces of the film may be configured to adhere to a substrate. Page 9, lines 15-19.

The at least one open aperture is located so as to align with a contact pad location of a substrate upon which the pre-formed solder mask is to be disposed. Page 9, lines 11-14, FIGs. 1 and 2. Additionally, the at least one open aperture may be configured to define a peripheral shape of a conductive structure to be formed on the contact pad of the substrate. Page 12, line 17, to page 13, line 22.

In addition to a pre-formed solder mask, the above-referenced patent application describes and includes claims that are drawn to a semiconductor device assembly that includes a substrate with a pre-formed solder mask, such as that described above, on the substrate. Page 8, lines 13-29; FIGs. 1-3.

(6) ISSUE

Whether any of claims 33-37 or 41-56 is obvious under 35 U.S.C. § 103(a) in view of the teachings of United States Patent 5,672,542 to Schwiebert et al. (hereinafter "Schwiebert").

(7) GROUPING OF CLAIMS

Claims 33-37 and 41-56 are commonly rejected as being unpatentable over Schwiebert. Claims 33-37 and 41-56 should be grouped together. Claim 33 appears to be the most generic claim of Group 1. For purposes of this appeal, claims 34-37 and 41-56 stand with claim 33, but claims 48 and 56 do not fall with claim 33.

(8) ARGUMENT

Rejection Under 35 U.S.C. § 103(a)

Claims 33-37 and 41-56 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the teachings of Schwiebert.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Schwiebert

Schwiebert teaches a method of using a stencil to form solder bumps 338 on substrates. Col. 1, lines 9-14. Specifically, Schwiebert teaches placing a solder mask 326 with multiple apertures 330 onto a substrate 320. The apertures 330 of the solder mask 326 correspond to the

locations of wettable regions 322 (i.e., contact pads) on substrate 320. Col. 6, lines 25-33; FIGs. 3A-3D. "The mask aperture 330 dimensions are generally (but are not required to be) somewhat larger than the dimensions of the wettable regions 322." Col. 7, lines 50-53. The apertures 330 of the solder mask 326 serve two purposes; namely, they act as a reservoir for the metal paste to be deposited and "act as a dam . . . to contain the paste until and during the reflow process." Col 6, lines 40-45. Notably, the solder mask 326 remains in place during both the deposition and re-flow processes. Col. 6, lines 46-49; col. 10, lines 45-47.

A dollop of metal paste is "squeegeed" into the solder mask 326 apertures 330. Col. 7, lines 66-67; col. 8, lines 1-2; FIG. 3B. The solder paste is a metal powder mixed with a flux vehicle. Col. 8, lines 18-19.

The solder paste is re-flowed by heating the entire assembly, which includes the substrate 320, the solder mask 326, and the solder paste. Col. 9, lines 53-55; FIG. 3C. As the assembly is heated, metal spheres 334 of the solder paste melt and coalesce into a single sphere or solder bump 338. Col. 9, lines 55-57. As the metal spheres 334 of the solder paste melt and coalesce, the solder moves out of contact with the surfaces of the apertures 330. *See* col. 5, lines 63-65.

In this regard, Schwiebert also teaches that the distance a solder bump 338 pulls away from the surface of an aperture 330 of the solder mask 326, or "bump-to-mask clearance," may be determined by the equation $c = (L - D)/2$, where L is the size of an aperture 330 and D is the diameter of a re-flowed solder bump 338 within the aperture 330. Col. 5, lines 44-52. Schwiebert illustrates such bump-to-mask clearance in FIG. 1B and FIG. 3C, which depict c as

being the distance between a sidewall of an aperture 330 and the closest point on the surface of the solder bump 338. As shown and described by Schwiebert, the bump-to-mask clearance is clearly greater than zero.

Claims 33-37 and 41-56

It is respectfully submitted that there are at least two reasons that a *prima facie* case of obviousness cannot be established against any of claims 33-37 and 41-56 based on the teachings of Schwiebert.

There is No Motivation to Modify the Teachings of Schwiebert

First, it is respectfully submitted that the teachings of Schwiebert are not sufficient to render the claims of the present invention *prima facie* obviousness because one of ordinary skill in the art would not have been motivated to modify the teachings of Schwiebert in the manner that has been asserted.

In particular, the proposed modification would change the principle of operation of the invention that is taught in Schwiebert. The principle of operation of the solder mask 326 taught in Schwiebert is two-fold. First, the apertures 330 of the solder mask 326 serve as reservoirs for solder paste. Second, the apertures 330 of the solder mask 326 serve as dams to retain liquid solder bumps 338 as they form during the reflow process. Col. 6, lines 40-45. In contrast, the apertures recited in independent claims 33, 43, and 49 serve to define a peripheral shape of the

conductive structure (i.e., provide a mold for the conductive material) and place the conductive structure on a substrate contact pad.

Even assuming, *arguendo,* that the apertures 330 in Schwiebert could be modified to define a peripheral shape, there is no suggestion or motivation to do so. The solder paste placed into each aperture 330 contains both conductive metal powder (conductive material) and flux. Col. 8, lines 18-19. As the solder paste is melted, the metal powder coalesces into a solder bump 338. Col. 9, lines 55-56. As a result, the flux is displaced to the region between the aperture 330 and the surface of the solder bump 338, filling the space referred to in Schwiebert as the bump-to-mask clearance, c. The solder bump 338 formed in this liquid environment takes on a rounded or spherical shape above the wettable region 322 because there are no forces exerted by the rigid side walls of the aperture 330 on the surface of the solder bump 338.

Based on the foregoing, it is respectfully submitted that any motivation to modify the teachings of Schwiebert in the manner that has been asserted could only have been based improperly on the benefit of hindsight provided by the above-referenced application.

Therefore, it is respectfully submitted that there is no suggestion or motivation to modify the teachings of Schwiebert in the manner that has been asserted.

Schwiebert Does Not Teach or Suggest Each and Every Claim Element

Second, Schwiebert cannot support a *prima facie* case of obviousness against any of claims 33-37 or 41-56 because Schwiebert fails to teach or suggest all the limitations of these claims.

Each of independent claims 33, 43, and 49 recites a pre-formed solder mask that comprises polymer and that includes"at least one open aperture" which is "configured to define a peripheral shape of a conductive structure to be formed . . ." Independent claims 33 and 43 also recite that the at least one open aperture is located "correspondingly to a contact pad location of a substrate upon which the pre-formed solder mask is to be disposed." Independent claim 49 similarly recites " a pre-formed film of solder mask material . . . and at least one aperture" formed therethrough. Accordingly, the at least one open aperture is present before the preformed solder mask is placed on the surface of a substrate.

It is asserted in the Final Office Action dated June 14, 2002, that "the mask of the prior art is an independent entity separate from the substrate." Final Office Action, page 6, paragraph 1. However, this is not what Schwiebert teaches. Schwiebert states that "a polymer mask . . . applied to the surface of the substrate, with apertures formed by chemical, mechanical or plasma etching or laser ablating the desired size holes in the mask located above the wettable pads." (Emphasis supplied.) Col. 7, lines 24-28. Thus, the apertures are formed in the solder mask above the wettable pads after the polymer form which the solder mask is to be formed has been placed on the surface of the substrate.

Therefore, Schwiebert neither teaches nor suggests a pre-formed solder mask comprising a polymer with at least one open aperture that is located correspondingly to a contact pad or contact pad location of a substrate, as recited in each of independent claims 33, 43, and 49.

Independent claims 33, 43, and 49 also recite "at least one open aperture configured to define a peripheral shape of a conductive structure." It is asserted in the Final Office Action that "any opening on a mask indeed defines a peripheral region of contact area for which it is designed." Final Office Action, page 5, paragraph 5. This is not true. By virtue of its plain meaning, the phrase "peripheral shape" clearly refers to the external boundary or exterior surface of the conductive structure. Thus, the at least one aperture serves as more than just a dam to hold the solder within the aperture, it serves as a mold to give structure to the conductive material extending above the contact pad.

By way of contrast, Schwiebert teaches that a solder bump 338 is spaced apart from an aperture 330 to facilitate removal of the solder mask 326 from a semiconductor device on which the solder bump 338 has been formed. Col. 5, lines 63-65. In fact, Schwiebert provides a formula for precalculating the desired clearance between a solder bump 338 to be formed and the surface of an aperture 330 in which the solder bump 338 is to be formed. Further, the teachings of Schwiebert are limited to "two purposes" for the apertures 330. One purpose is to act as a reservoir to hold solder paste in position before a solder bump 338 is formed therefrom. Col. 6, lines 40-45. The other purpose is to act as a dam for containing the solder paste during the re-flow process. *Id.*

Moreover, Schwiebert states that "the mask aperture may be oblong and the BLM [i.e., wettable regions 322] circular or octagonal . . . [and that] upon reflow, the solder becomes spherical on the BLM [i.e., wettable region 322] circular pad." Col. 7, lines 55-57. Since the solder bump 338 is in a liquid state as it forms and adheres to the wettable region 322 and the aperture 330 is not used to shape or mold the solder bumps 338 above the wettable region 322, the solder bump 338 assumes the lowest energy configuration, which is a rounded or spherical shape. The result is a solder bump 338 with a bottom edge having the shape of the wettable region 322 and the region of the solder bump 338 above the wettable region 322 being rounded or spherical. Therefore, instead of indicating that the peripheral shape of the solder bump 338 is not defined by an aperture of a solder mask, Schwiebert makes it clear that it is the wettable region upon which the solder bump 338 is formed that defines the shape of the solder bump 338.

Therefore, Schwiebert does not teach or suggest each and every element of any of independent claims 33, 43, or 49.

Claims 34-37, 41, and 42 are each allowable, among other reasons, as depending either directly or indirectly from claim 33, which is allowable.

Each of claims 44-48 is allowable, among other reasons, as depending either directly or indirectly from claim 43, which is allowable.

Claims 50-56 are all allowable, among other reasons, as depending either directly or indirectly from claim 49, which is allowable.

Claims 48 and 56

Claims 48 and 56 are further allowable because Schwiebert lacks any teaching or suggestion of an adhesive material to adhere a solder mask to a substrate.

(9) APPENDICES

A copy of claims 33-37 and 41-56, as presently amended, is appended hereto as "Appendix A."

(10) CONCLUSION

It is respectfully submitted that each of claims 33-37 and 41-56 is allowable because a *prima facie* case of obviousness against these claims cannot be established based solely on the teachings of Schwiebert.

Accordingly, reversal of the 35 U.S.C. § 103(a) rejections of claims 33-37 and 41-56 is respectfully solicited.

Respectfully submitted,

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Date: November 14, 2002

APPENDIX A

33. A pre-formed solder mask, comprising:

a film of mask material comprising a polymer and having a substantially uniform thickness; and

at least one open aperture formed through said film and located correspondingly within said film to a contact pad location of a substrate upon which the pre-formed solder mask is to be disposed, said at least one open aperture configured to define a peripheral shape of a conductive structure to be formed on said contact pad.

34. The pre-formed solder mask of claim 33, wherein said at least one open aperture is configured to be positioned over and to expose a non-peripheral region of said contact pad.

35. The pre-formed solder mask of claim 33, wherein said substantially uniform thickness of said film substantially corresponds to a desired height of said conductive structure.

36. The pre-formed solder mask of claim 33, wherein said solder mask material is a polymer.

37. The pre-formed solder mask of claim 33, wherein said solder mask material is formulated to shrink or degrade upon exposure to at least one of radiation, a plasma, and a shrinking agent.

41. The pre-formed solder mask of claim 33, wherein said film is configured to be adhered to a substrate.

42. The pre-formed solder mask of claim 33, further comprising an adhesive on a surface of said film.

43. A pre-formed solder mask, comprising:

a film of solder mask material comprising a polymer and having a substantially uniform thickness, said film including a surface configured to be adhered to a substrate; and

at least one open aperture formed through said film and located correspondingly within said film to a contact pad location of a substrate upon which the pre-formed solder mask is to be disposed, said at least one open aperture configured to define a peripheral shape of a conductive structure to be formed on said contact pad.

44. The pre-formed solder mask of claim 43, wherein said at least one open aperture is configured to be positioned over and to expose a non-peripheral region of said contact pad.

45. The pre-formed solder mask of claim 43, wherein said substantially uniform thickness of said film substantially corresponds to a desired height of said conductive structure.

46. The pre-formed solder mask of claim 43, wherein said solder mask material is a polymer.

47. The pre-formed solder mask of claim 43, wherein said solder mask material is formulated to shrink or degrade upon exposure to radiation, a plasma, or a shrinking agent.

48. The pre-formed solder mask of claim 43, wherein said surface of said film includes an adhesive material.

49. A semiconductor device assembly, comprising:

a substrate including at least one contact pad;

a pre-formed film of solder mask material comprising a polymer and disposed on said substrate, said pre-formed film having a substantially uniform thickness; and

at least one open aperture formed through said pre-formed film and located correspondingly within said film to said at least one contact pad, said at least one open aperture configured to define a peripheral shape of a conductive structure to be formed therein.

50. The semiconductor device assembly of claim 49, further comprising a conductive structure substantially filling said at least one open aperture and in communication with said at least one contact.

51. The semiconductor device assembly of claim 50, wherein said conductive structure protrudes beyond an exposed surface of said pre-formed film.

52. The semiconductor device assembly of claim 49, wherein said at least one open aperture is positioned over and exposes a non-peripheral region of said at least one contact pad.

53. The semiconductor device assembly of claim 49, wherein said substantially uniform thickness of said pre-formed film is substantially equal to a height of said conductive structure.

54. The semiconductor device assembly of claim 49, wherein said solder mask material is a polymer.

55. The semiconductor device assembly of claim 49, wherein said solder mask material is formulated to shrink or degrade upon exposure to at least one of radiation, a plasma, and a shrinking agent.

56. The semiconductor device assembly of claim 49, wherein said surface of said pre-formed film includes an adhesive material.